Dear Potential Partner with State of Michigan OrthoImagery Acquisition

The following pages contain an example metadata document from the Southeast Michigan Council Of Governments (SEMCOG).

The metadata contains the type of information that is necessary to properly document the aerial imagery product that you will be receiving from your vendor.

You are encouraged to provide this example to your vendor and let the vendor know that the State of Michigan requires a metadata document as part of the partnership, and that you would like the vendor to provide you a metadata similar in quality and completeness to the SEMCOG metadata as part of the imagery deliverables.

For questions to do with the metadata, feel free to refer the vendor to Mr. Dan Metzger of the Michigan Center for Geographic Information (CGI) at 517-373-7910 or MetzgerD@Mi.gov.

Identification_Information:
Citation:
Citation_Information:
Originator: <partner specific>
Publication_Date: 20060516
Title: Southeast Michigan 2005 Orthoimagery (HARN)
Edition: 1
Geospatial_Data_Presentation_Form: remote-sensing image
Description:
Abstract:
The Southeast Michigan Regional Orthoimagery project encompasses approximately 5000 square miles, which includes an additional ½ mile buffer beyond the boundary of the seven county region. This extends approximately 500 feet into Canada. The orthoimagery is true color with a base pixel resolution of 2 feet that were resampled from the County 6 inch pixel base. These files are created using EarthData proprietary software. The original 6 inch natural color orthos are input into the software with the desired pixel out put specified.

Orthoimagery tiles were delivered in Tiff format with Tiff world files representing ground dimensions of 2000' x 3000'. Tile naming convention includes the county code, the third and fourth digit of the lower left X and the first three digits of the lowerY coordinate and the year flown. For example 161 2005, tile name would be 1612932405). Countywide MrSids are compressed at 50 to 1 using the 2 foot pixel imagery.

All control was based on the following
-Michigan State Plane (South)
-Horizontal datum -North American Datum (NAD 83)HARN international feet second-order class I.
-Vertical datum - North American Vertical Datum 1988 (NAVD88) international feet, third-order class I.
-HARN for counties already using it.
All imagery was taken in the spring of 2005. Acquisition was attempted when the ground was not obscured by haze, smoke, dust, clouds or cloud shadows, and snow or ice. Flights were scheduled when solar angle was at least 30 degrees or more above the horizon
Orthoimagery complies with the American Society for Photogrammetry and Remote Sensing Accuracy Standards for Class 1 mapping requirements.
Purpose:
The Southeast Michigan Regional Orthoimagery Project was a coordinated effort to acquire digital orthoimagery in Spring 2005 for the seven county Southeast Michigan region.
Southeast Michigan Council of Governments lead the partnership in cooperation with Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties, the State of Michigan, United States Geological Survey and the Detroit Water and Sewerage Department.
The local cities, villages, and townships will benefit through their partnership with the counties.
-Cost savings to partners through cost sharing and coordinated project management.
-Cost savings through economies of scale by contracting with a single vendor.
-Sharing the combined experiences of all partners, resulting in high-quality regional imagery for the same year.

-Drawing from each county partner's expertise, staff resources, and ownership commitment, they will be responsible for their own QA/QC process using common standards and training.
-Providing a partnership framework for future updates of imagery after 2005.

Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: 20060516
  Currentness_Reference: Publication Date
Status:
  Progress: Complete
  Maintenance_and_Update_Frequency: <partner specific>
Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: -084.173891
    East_Bounding_Coordinate: -082.392011
    North_Bounding_Coordinate: +43.195625
    South_Bounding_Coordinate: +41.697475
Keywords:
  Theme:
    Theme_Keyword_Thesaurus: None
    Theme_Keyword: Digital Orthos
    Theme_Keyword: Orthophotography
    Theme_Keyword: Imagery
    Theme_Keyword: Aerial photography
    Theme_Keyword: Air photos
    Theme_Keyword: Aerotriangulation
    Theme_Keyword: GPro
    Theme_Keyword: ADS40
    Theme_Keyword: DSM
    Theme_Keyword: Digital Surface Model
    Theme_Keyword: DEM
    Theme_Keyword: Digital Elevation Model
  Place:
    Place_Keyword_Thesaurus: None
    Place_Keyword: SEMCOG
    Place_Keyword: Livingston County
    Place_Keyword: Macomb County
    Place_Keyword: Monroe County
    Place_Keyword: Oakland County
    Place_Keyword: St. Clair County
    Place_Keyword: Washtenaw County
    Place_Keyword: Wayne County
    Place_Keyword: Southeast Michigan
Access_Constraints: <partner specific>
Use_Constraints: <partner specific>
Point_of_Contact:
  Contact_Information:
    Contact_Person_Primary:
      Contact_Person: <partner specific>
      Contact_Organization: <partner specific>
    Contact_Position: <partner specific>
    Contact_Address:
      Address_Type: mailing and physical address
      Address: <partner specific>
      City: <partner specific>
      State_or_Province: <partner specific>
      Postal_Code: <partner specific>
      Country: <partner specific>
    Contact_Voice_Telephone: <partner specific>
    Hours_of_Service: <partner specific>

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
This data has been produced to be fully compliant with the
American Society for Photogrammetry and Remote Sensing
Accuracy Standards for Class 1 mapping requirements.
Logical_Consistency_Report:
Compliance with the accuracy standard was ensured by
the collection of photo identifiable GPS ground control
after the acquisition of aerial imagery. The following checks
were performed.
1. The ground control and airborne GPS data stream were
validated through a fully analytical bundle aerotriangulation
adjustment. The RMSE is less than 1, 10,000th of the flying height.
2. The DSM (for True Ortho areas) or DEM (for ground
ortho areas) data was checked against the project control.
The technician visited and confirmed the accuracy of the
points during initial processing
3. Digital orthophotography was validated through an
inspection of edge matching and visual inspection for
image quality.
Completeness_Report:
The following methods are used to assure imagery
accuracy.
1. Use of IMU (inertial measurment unit) and ground control network utilizing GPS
techniques.
2. Use of airborne GPS (global positioning system) in conjunction with the
acquisition of imagery.
The following software is used for validation of the imagery
and surface modeling
1. Aerotriangulation - GPro and ISTAR
2. DSM and DEM data - GPro and ISTAR
3. Digital Orthophotography - ISTAR
4. Bentley - MicroStation
5. GPro
6. ISTAR
7. ESRI - ArcInfo
8. ERDAS Imagine
9. Terrascan
10. EarthData proprietary software
11. Adobe - Photoshop
12. Socetset
13. Horizons proprietary software
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
This data has been produced to be fully compliant with the
American Society for Photogrammetry and Remote Sensing
Accuracy Standards for Class 1 mapping requirements.
+/- 1 foot at 68.3 percent accuracy.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report:
The surface model meets and accuracy of 2 meters or 7
feet RMSE.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: EarthData Aviations
Publication_Date: 20050520
Title: Aerial Imagery Acquisition
Edition: 1
Geospatial_Data_Presentation_Form: remote-sensing image

Source_Scale_Denominator: 1200
Type_of_Source_Media: firewire
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 20050412
Ending_Date: 20050520
Source_Currentness_Reference: Ground Condition
Source_Citation_Abbreviation: Aerial Acquisition
Source_Contribution:
The aerial imagery acquisition for Southeast Michigan was flown to support the creation of digital orthophotography with a 6-inch pixel. The imagery was acquired in thirty-two sorties, the sorties were varying in size. The imagery were flown at 5,300 feet AMT. Imagery was flown with a 30% overlap between flight lines except in the areas of downtown Detroit where the imagery was flown with a 60-80% overlap to support the generation of True Ortho imagery. All imagery was collected using the Leica ADS40 digital pushbroom sensor.
Source_Information:
Source_Citation:
Citation_Information:
Originator: Wade Trim
Publication_Date: 20050527
Title: Ground Control
Edition: 1
Geospatial_Data_Presentation_Form: model
Source_Scale_Denominator: 1200
Type_of_Source_Media: Electronic Mail and USPS
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 20050505
Ending_Date: 20050527
Source_Currentness_Reference: Ground Condition
Source_Citation_Abbreviation: Ground Control
Source_Contribution:
Wade Trim was contracted by EarthData to acquire 60 photo identifiable ground control points after the acquisition of aerial imagery. The ground control points were established using GPS for vertical and horizontal coordinate values.
NAD 83 (HARN)
NAVD 88
International Feet
Process_Step:
Process_Description:
Two separate work flows were used to complete the aerotriangulation on the project. ISTAR was used in the True Ortho area (Detroit City) and Leica GPro was used for the Ground Ortho areas (the remainder of the project). For both work flows the airborne GPS data were processed and integrated with the inertial measurement unit (IMU). For the True Ortho areas the results were imported into the ISTAR system for use in the aerotriangulation. The ADS40 imagery was downloaded onto the EarthData server and brought over to the UNIX based ISTAR system. The ground control was used in conjunction with the processed airborne global positioning system (ABGPS) results for the aerotriangulation. The ground control points were read in all available imagery and tie points between flight lines were selected. A fully analytical bundle

adjustment was run. The properly formatted ISTAR
results were used for subsequent processing.
For the Ground Ortho area the results were imported into
the GPro system for use in the aerotriangulation.
Aerotriangulation of ADS40 imagery were performed using,
the Socet Set Automatic Point Measurement (APM) tool to
select the pass point between the selected bands and
ORIMA to perform the analytical aerotriangulation bundle
adjustment of the measurements recorded.
Aerotriangulation was performed using three bands; the
backward viewing pan band, the green band at nadir view
and the green forward viewing band. The ground control
points were read in all available imagery and tie points
between flight lines were selected. A fully analytical
bundle adjustment was run. The properly formated results
were used for subsequent processing.
Source_Used_Citation_Abbreviation: Aerotriangulation
Process_Date: 20060315
Source_Produced_Citation_Abbreviation: AT
Process_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: EarthData International
Contact_Person: Raquel Charrois
Contact_Position: Project Manager
Contact_Address:
Address_Type: mailing and physical address
Address: 7320 Executive Way
City: Frederick
State_or_Province: MD
Postal_Code: 21704
Country: USA
Contact_Voice_Telephone: (301)-948-8550
Contact_Facsimile_Telephone: (301)-963-2064
Contact_Electronic_Mail_Address: rcharrois@earthdata.com
Hours_of_Service: Mon - Fri 9:00am to 5:00pm
Process_Step:
Process_Description:
Two separate work flows were used to complete the
surface model on the project. ISTAR was used in the
True Ortho area (Detroit City) and Leica GPro was used
for the Ground Ortho areas (the remainder of the project).
This process describes the ISTAR surface modeling for the
True Ortho area. ISTAR digital surface modeling is based
on an auto correlated pixel-matching system within the
ISTAR software. The auto correlated digital surface model
(DSM) surface represents the initial surface model. The post
spacing was generated at 2 meters.
The following is a step-by-step breakdown of the process.
1. Using the DSM ISTAR data set created, the technician
performed a visual inspection of the data to verify that the
flight lines met correctly. The technician
also verified that there were no voids, and that the data
covered the project limits. The technician then selected a
series of areas from the dataset and inspected them where
adjacent flight lines met.
2. This DSM surface is used in the rectification of True
Ortho imagery.
This process describes the surface modeling for the Ground
Ortho areas. Socet Set digital surface modeling is based on
an auto correlated pixel-matching system. Using the ADS40
Level-1 imagery and the Socet Set Automatic Terrain
Extraction (ATE) tool, a DEM surface with a 2 meter post

spacing was autocorrelated. ATE and ITE (Interactive Terrain Edit) are both tools in Socet Set that were used to generate and edit the DTM data. With ATE, a terrain adaptive image correlation strategy is used to create a DTM regular grid with specified post spacing. DTM grid files are created for each flight line. In ITE, buildings, trees, and all other areas that ATE could not correctly correlate were manually removed. The edited DTM data was directly used in GPro to rectify the Level-2 ortho strips.
The following is a step-by-step breakdown of the process.
1. Using the DEM data set created, the technician performed a visual inspection of the data to verify that the flight lines met correctly. The technician also verified that there were no voids, and that the data covered the project limits. The technician then selected a series of areas from the dataset and inspected them where adjacent flight lines met. A process, which utilizes ITE was run to detect the differences in elevation values and profiles. The technician reviewed the results and located the areas that contained systematic errors or distortions that were introduced by the auto correlation.
2. Systematic distortions highlighted in step 1 were removed and the data were re-inspected. Corrections and adjustments can involve the application of angular deflection or compensation for curvature of the ground surface that can be introduced by crossing from one type of land cover to another.
3.The data was checked against the control network to ensure that vertical requirements were maintained.
4. Data was merged into countywide data sets and converted to ESRI float grid format.

Source_Used_Citation_Abbreviation: Digital Surface Model
Source_Used_Citation_Abbreviation: Digital Elevation Model
Process_Date: 20060330
Source_Produced_Citation_Abbreviation: DSM and DEM
Process_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: EarthData International
Contact_Person: Raquel Charrois
Contact_Position: Project Manager
Contact_Address:
Address_Type: mailing and physical address
Address: 7320 Executive Way
City: Frederick
State_or_Province: MD
Postal_Code: 21704
Country: USA
Contact_Voice_Telephone: (301)-948-8550
Contact_Facsimile_Telephone: (301)-963-2064
Contact_Electronic_Mail_Address: rcharrois@earthdata.com
Hours_of_Service: Mon - Fri 9:00 am to 5:00 pm

Process_Step:
Process_Description:
The digital orthophotography is comprised of a natural color 2 foot pixel resolution ground orthos for the counties of Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw and Wayne. True Ortho imagery was generated in downtown Detroit (Wayne County).
Two sparate work flows were used to completed the orthophoto production. ISTAR was used in the True Ortho area (DEtroit Citty) and Leica GPro was used for the Ground Ortho areas (the remainder of the project).

This process describes the True Ortho production. The initial radiometric adjustments were performed on the imagery for each flight line attempting to reach the best possible histogram. The rectification process was then run using the processed DSM surface and the radiometrically balanced imagery on each flight line. The quicklook (reduced resolution rectification) of each flight line exported out of ISTAR. A second set of radiometric adjustments were made using EarthData proprietary tools. The radiometrically balanced imagery was then re-imported into the ISTAR system and the histogram from the quicklook was applied to the full resolution imagery. Mosaic lines were placed, joining the ADS40 imagery strips. In initial QA/QC was performed by the technician to ensure that the mosaic lines were appropriately placed and that there was appropriate imagery coverage. The final imagery data set is removed from the ISTAR environment in a process called "packaging" where the individual tiles are created. All data processing in the ISTAR system is performed in UTM meters; it is during packaging that final datum and projection are defined. The created tiles are reviewed again for anomalies and interactive radiometric adjustment applied where needed. QA/QC was performed looking for anomalies, smears and other indications of problems within the digital Orthophoto creation process, interactive radiometric adjustment applied where needed. Two additional radiometric adjustments are applied to the completed orthos in Adobe Photoshop. The first is a sharpening mask filter; this filter is used to help increase sharpness of a digital image. The basis for this filter is to locate pixels that differ in value from surrounding pixels by the threshold specified. It then increases the pixels' contrast by the value identified. For neighboring pixels specified by the threshold, the lighter pixels get even lighter and the darker pixels get even darker based on the specified amount. The changes made maintained the integrity of the original histogram curve. The settings used were
Filter Sharpen Unsharp Mask
Amount 250%
Radius 1.0 Pixels
Threshold 0 Levels
Image Adjustments Color Balance.
-12 Green
Midtones
Image Adjustments Brightness/Contrast.
+15
The final digital ortho product was TIFF with TFW.
This process describes the Ground Ortho production. Ortho-rectification is performed in GPro for the entire image strip at once, which is more efficient that managing many frame images. GPro resamples the original Level-0 image with the refined orientation produced by aerotriangulation and the requisite DEM. After the creation of the Orthophotos using GPro, the images are run through a proprietary program that adjusts the gradient across each image to improve the tone balance of the images. This program also breaks the ADS40 orthophoto strip into more manageable overlapping tiles. These orthophotos are then imported into ORTHOVISTA where radiometric and color corrections are made on multiple flight lines at once. Upon completion the images are imported into horizons'

proprietary image software. Images are mosaicked together using a "path of least resistance" algorithm to generate seam lines. When the initial database is generated, the technician overlays the DEM to check for correct orientations and obvious image errors. The technician then systematically goes through the database looking at every seam. If a seam is noticeable and can be lessened or be made "invisible" by moving the seam; the Technician will evaluate the overlapping image tiles to choose the "best fit" and mosaic the "new" seam line into the image database. Once all of the seam lines have been checked and corrected ortho tiles are then clipped from the image database and put through a thorough Q/C process. Any discrepancies found are marked and corrected inside of the image database. Once this process is complete the final ortho tiles are clipped from the database. Two additional radiometric adjustments are applied to the completed orthos in Adobe Photoshop. The first is a sharpening mask filter; this filter is used to help increase sharpness of a digital image. The basis for this filter is to locate pixels that differ in value from surrounding pixels by the threshold specified. It then increases the pixels' contrast by the value identified. For neighboring pixels specified by the threshold, the lighter pixels get even lighter and the darker pixels get even darker. The changes made maintained the integrity of the original histogram curve. The settings used were
Filter Sharpen Unsharp Mask
Amount 250%
Radius 1.0 Pixels
Threshold 0 Levels
Image Adjustments Color Balance.
-12 Green
Midtones
Image Adjustments Brightness/Contrast.
+15
The final digital ortho product was TIFF with TFW.

Source_Used_Citation_Abbreviation: Digital Orthophotos
Process_Date: 20050516
Source_Produced_Citation_Abbreviation: Digital Orthos
Process_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: EarthData International
Contact_Person: Raquel Charrois
Contact_Position: Project Manager
Contact_Address:
Address_Type: mailing and physical address
Address: 7320 Executive Way
City: Frederick
State_or_Province: MD
Postal_Code: 21704
Country: USA
Contact_Voice_Telephone: 301-948-8550
Contact_Electronic_Mail_Address: rcharrois@earthdata.com
Hours_of_Service: Mon - Fri 9:00 am to 5:00 pm

Cloud_Cover: 0

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Pixel

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:

```
                Grid_Coordinate_System:
                        Grid_Coordinate_System_Name: State Plane Coordinate System 1983 HARN
                        State_Plane_Coordinate_System:
                                SPCS_Zone_Identifier: 2113
                                Lambert_Conformal_Conic:
                                        Standard_Parallel: 42.100000
                                        Standard_Parallel: 43.666667
                                        Longitude_of_Central_Meridian: -084.366667
                                        Latitude_of_Projection_Origin: +41.500000
                                        False_Easting: 13123359.580052
                                        False_Northing: 0.000000
                Planar_Coordinate_Information:
                        Planar_Coordinate_Encoding_Method: coordinate pair
                        Coordinate_Representation:
                                Abscissa_Resolution: 2
                                Ordinate_Resolution: 2
                        Planar_Distance_Units: International Feet
        Geodetic_Model:
                Horizontal_Datum_Name: North American Datum of 1983
                Ellipsoid_Name: Geodetic Reference System 80
                Semi-major_Axis: 6378137.000000
                Denominator_of_Flattening_Ratio: 298.257222
Distribution_Information:
        Distributor:
                Contact_Information:
                        Contact_Person_Primary:
                                Contact_Person: <partner specific>
                                Contact_Organization: <partner specific>
                        Contact_Position: <partner specific>
                        Contact_Address:
                                Address_Type: mailing and physical address
                                Address: <partner specific>
                                City: <partner specific>
                                State_or_Province: <partner specific>
                                Postal_Code: <partner specific>
                                Country: <partner specific>
                        Contact_Voice_Telephone: <partner specific>
                        Hours_of_Service: <partner specific>
        Distribution_Liability: <partner specific>
Metadata_Reference_Information:
        Metadata_Date: 20060516
        Metadata_Review_Date: 20060516
        Metadata_Contact:
                Contact_Information:
                        Contact_Organization_Primary:
                                Contact_Organization: EarthData International
                                Contact_Person: Raquel Charrois
                        Contact_Position: Project Manager
                        Contact_Address:
                                Address_Type: mailing and physical address
                                Address: 7320 Executive Way
                                City: Frederick
                                State_or_Province: MD
                                Postal_Code: 21701
                                Country: USA
                        Contact_Voice_Telephone: (301)948-8550
                        Contact_Facsimile_Telephone: (301)963-2064
                        Contact_Electronic_Mail_Address: rcharrois@earthdata.com
                        Hours_of_Service: Mon to Fri 9:00 am to 5:00 pm
        Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
        Metadata_Standard_Version: FGDC-STD-001-1998
        Metadata_Use_Constraints: None
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